NAME: _____ ( ) CLASS: _____ MARKS: _____

TIMED TRIAL: # 1 TIME START: _____ TIME END: _____ DURATION: _____

Answer ALL the questions. Show all working.
Write your answers in the spaces provided. Take g to be 10 N kg^{-1} where necessary.

1. A car of mass 1 000 kg started from rest and moved along a straight road with a constant acceleration of 3.0 ms^{-2} for 6 s.

(a) Calculate the speed of the car 6 seconds after it started to move. [1]

$a = \frac{v-u}{t}$ $\therefore$ $v = u + at$

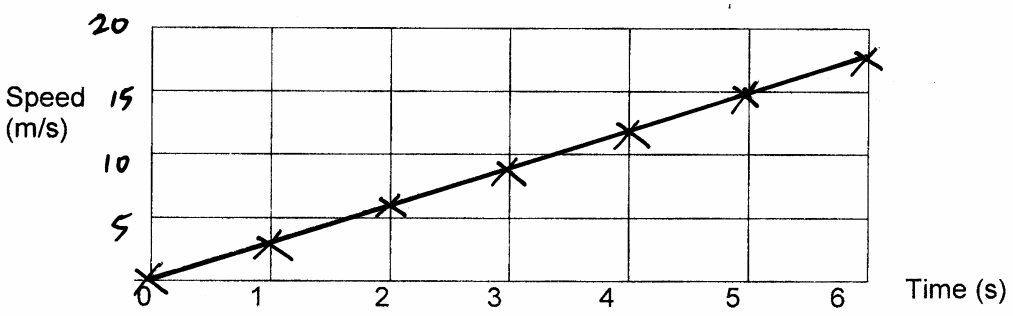
$= 0 + (3.0)(6) = 18\ ms^{-1}$

(b) Calculate the resultant force acting on the car. [1]

$F = ma = (1000\ kg)(3.0\ ms^{-2})$

$= 3000\ N$

(c) On the axes below, draw a speed-time graph for the first 6 seconds of the car's motion. Fill in the value(s) for the y-axis. [2]



(d) Calculate the distance moved by the car in the first 6 seconds. [1]

distance travelled = area under speed-time graph

$= \frac{1}{2}(6)(18)$

$= 54\ m$

(e) Calculate the average speed of the car in the first 6 seconds. [1]

$S = \frac{D}{T} = \frac{54\ m}{6\ s} = 9.0\ ms^{-1}$

2. A horizontal force of 5.0 N was applied to a block of mass 2.0 kg resting on a frictionless table.

(a) What was the acceleration of this block? [1]

$F = ma$

$a = \frac{F}{m} = \frac{5.0}{2.0} = 2.5\ ms^{-2}$

(b) What is the acceleration if there is now a frictional force of 1.5 N? [2]

$F - friction = ma$

$5.0 - 1.5 = (2.0)\,a$

$a = \frac{3.5}{2.0} = 1.75\ ms^{-2} \simeq 1.8\ ms^{-2}$

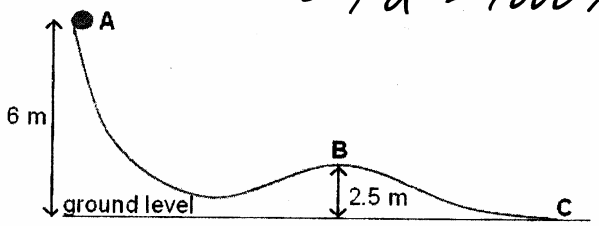
3. A rectangular glass block of dimensions 30.0 cm by 50.0 cm by 10.0 cm weighs 30 N. Calculate the greatest pressure it can exert when resting on a horizontal table. [2]

$P = \frac{F}{A} = \frac{W}{A}$ $\quad P_{max} = \frac{W}{A_{min}} = \frac{30\ N}{10.0\ cm \times 30.0\ cm}$

$= \frac{30\ N}{0.1\ m \times 0.3\ m}$

$= 1000\ Pa = 1000\ Nm^{-2}$

4. A ball of mass 0.8 kg was released from rest at A and travelled, with negligible air resistance, down a frictionless slope as shown in the figure below. *Assume G.P.E. to be zero at ground level.* (Take g = 10 N kg^{-1})



(a) What is the weight of the ball? [1]

$W = mg = (0.8\ kg)(10\ N\ kg^{-1}) = 8.0\ N$

(b) What is the gravitational potential energy at A? [1]

$G.P.E = mgh = (0.8)(10)(6) = 48\ J$

(c) Calculate the kinetic energy of the ball when it is at B. [2]

Loss in G.P.E at A = Gain in K.E. at B

$mgh = \frac{1}{2}mv^2 =$ K.E at B

K.E. at B $= (0.8)(10)(6 - 2.5)$

$= 28\ J$

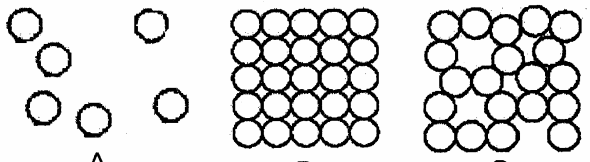
5. The figure below illustrates the arrangement of molecules of a substance in different states of matter.

(a) State which arrangement A, B or C represents the structure of [3]

the solid, B

the liquid, C

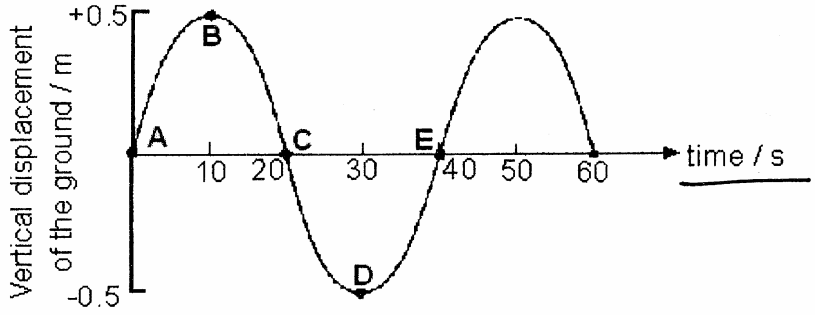
the gas. A



(b) Explain why the density of the gas is lower than that of the solid. [1]

For the same unit volume, there are less mass (due to less particles) for gas compared to that of solid, so the $\frac{\text{mass}}{\text{volume}}$ ratio is smaller for gas compared to solid, and density = $\frac{\text{mass}}{\text{volume}}$.

6. An earthquake produces seismic waves which travel around the surface of the earth at a speed of about 6 km/s. The figure below shows how the ground moves near the centre of the earthquake as the wave pass.



(a) What is the period of the waves? [1]

$T = 40$ s [one complete sine curve]

use

(b) What is the frequency of the waves? [1]

$f = \frac{1}{T} = \frac{1}{40}$ Hz $= 0.025$ Hz

(c) Calculate the wavelength of the seismic waves. [1]

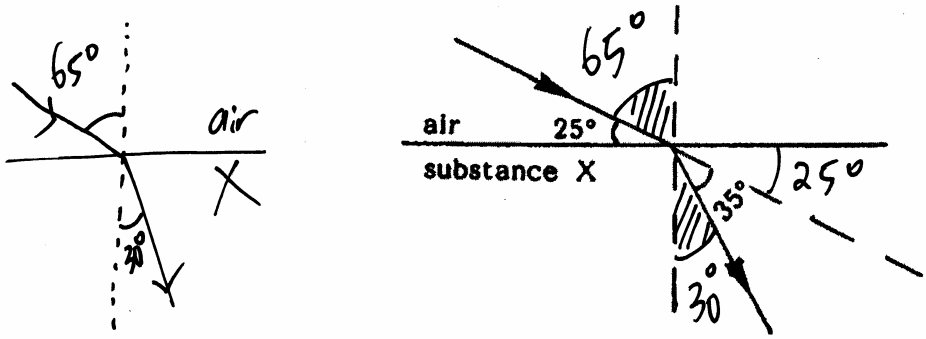
$v = f\lambda$

$6000 \text{ m/s} = (0.025 \text{ Hz})\,\lambda$

$\lambda = \frac{6000}{0.025} = 240000$ m

(3)

7. A ray of light passes from air into a transparent block made of substance **X**.



(a) State the values for the angle of incidence and angle of refraction? [2]

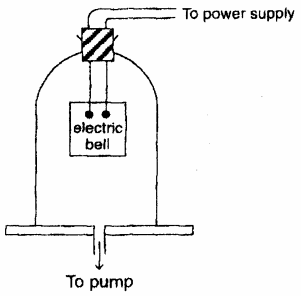
$\angle i = 65°$ (in air) $\angle r = 30°$ (in X)

(b) What is the refractive index of substance **X**? [1]

$n = \frac{\sin(\text{bigger } \angle)}{\sin(\text{smaller } \angle)} = \frac{\sin 65}{\sin 30} = 1.8126 \simeq 1.8$

8. An electric bell is suspended by thin connecting wires inside a bell jar as shown.

The bell is set ringing and air extracted from the bell jar by means of a pump.



(a) What would be observed as the air is slowly drawn out by the pump? [2]

The sound from the bell would be softer and softer, but the electric bell is still seen vibrating at the same rate.

(b) What may be deduced from this experiment? [1]

Sound cannot travel in a vacuum, and sound needs a medium to travel in.

(c) Why must the bell be suspended inside the bell jar, and not just placed on the bottom? [1]

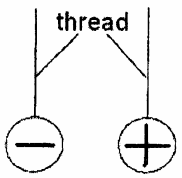
Placed at the bottom the sound from the electric bell will travel through the glass bell jar and through the base of the bell jar.

4

9. (a) State the S.I. unit for charge. [1]

Coulomb [C]

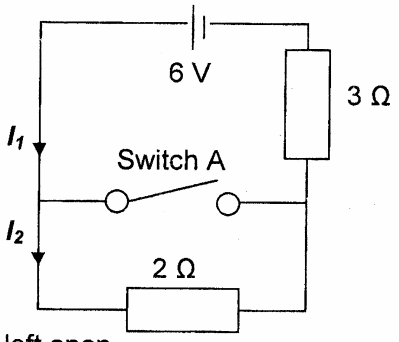
(b) Polystyrene balls are charged as shown below. They are suspended and brought close together.



State and explain what you would observe. [1]

They move towards each other as unlike charges attract, and move back apart upon neutralisation.

10. The circuit shown in the figure below is as set up.



(a) If switch A is left open, OPEN

(i) calculate the effective resistance of the circuit [1]

$R_T = R_1 + R_2 = 2 + 3\ \Omega = 5.0\ \Omega$

(ii) calculate the currents I_1 and I_2. [2]

$I_1 = I_2 = \frac{V}{R_T} = \frac{6}{5} = 1.2\ A$

$I_1 = 1.2\ A,\ I_2 = 1.2\ A$

(b) If switch A is closed, calculate the currents I_1 and I_2. [2]

A is closed, short circuit across 2 Ω resistor,

$I_2 = 0\ A$

$I_1 = \frac{V}{R_{new}} = \frac{6}{3} = 2.0\ A$

(5)

11. When a 1.5 V cell was connected to the ends of a 2 m length of wire, there was a current of 0.25 A flowing in the wire.

(a) Calculate the resistance of the wire. [1]

$$R = \frac{V}{I} = \frac{1.5}{0.25} = 6.0\ \Omega$$

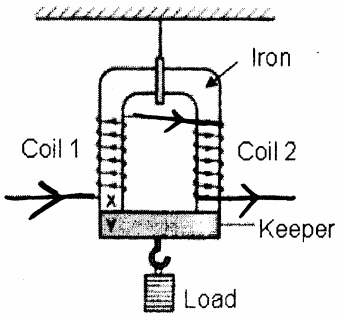
(b) Calculate the resistivity of the wire material if the wire has a cross-sectional area of $4 \times 10^{-7}\ m^2$. [1]

$$R = \rho\frac{L}{A} \qquad \rho = R\frac{A}{L} = (6.0)\left(\frac{4\times10^{-7}}{2}\right) = 0.00000012\ \Omega m$$

(c) What would be the resistance of 2 m of wire of the same material but with a cross-sectional area double that of the original wire? [1]

$$R = \rho\frac{L}{A} = \rho\frac{L}{2A} = \frac{1}{2}\rho\frac{L}{A} = \frac{1}{2}(6.0\ \Omega) = 3.0\ \Omega$$

12. The figure shows an electromagnet with a direct current passing through the coil used to lift a load



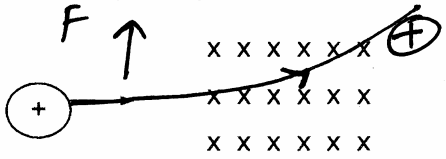
(a) State the polarity of X and polarity of Y? [2]

X : N-pole Y : S-pole

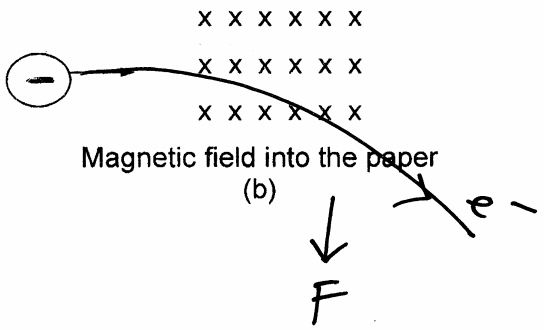
(b) Suggest two modifications to be made to the electromagnet to enable a heavier load to be lifted. [2]

- More turns of coil of solenoid
- larger current in coil

13. Complete the diagrams by drawing the path of (a) positively charged particles and (b) negatively charged particles that move in a magnetic field. [2]



Magnetic field into the paper
(a)



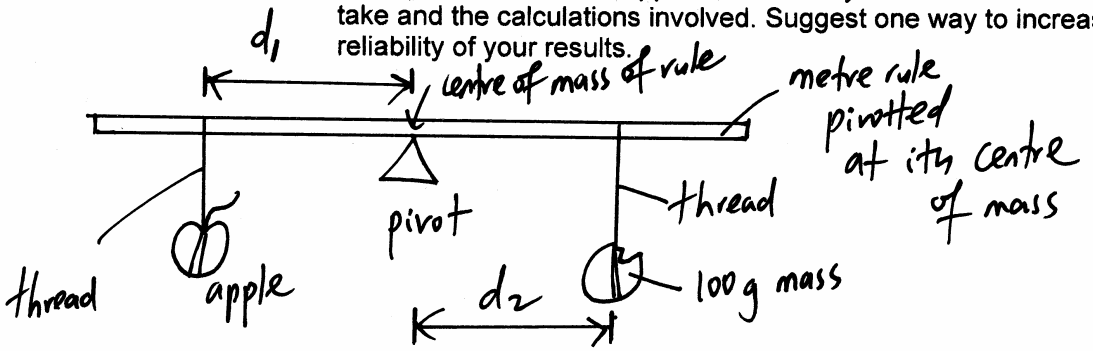
Magnetic field into the paper
(b)

6

14(a) You are required to find the mass of an apple by using only the following and appropriate laboratory apparatus:

- metre rule
- pivot
- some threads
- one piece of 100g mass

With the help of a labelled diagram, describe how you would go about finding the mass of the apple. State clearly the measurements you would take and the calculations involved. Suggest one way to increase the reliability of your results. [5]



(1) Set up the experiment as shown in the diagram shown

(2) Balance the metre rule on the pivot, and note down the position at which it balances. This position is the centre of mass of metre rule.

(3) Pivot the metre rule at its centre of mass, and hang the 100 g mass with a thread such that d_2 is a distance of 20.0 cm away from the pivot.

(4) Slide the thread holding the apple along the metre rule until the metre rule is balanced, and determine d_1, the distance of the thread with apple from the pivot.

(5) By Principle of moments, about pivot, for equilibrium, $M_{ACW} = M_{CW}$

(b) (i) State one difference and one similarity in the magnetic properties between soft iron and hard steel. [1]

Difference: Soft iron does not retain magnetism well, unlike steel.

Similarity: Both are magnetic materials that can be electrically magnetised

Q14

Date No.

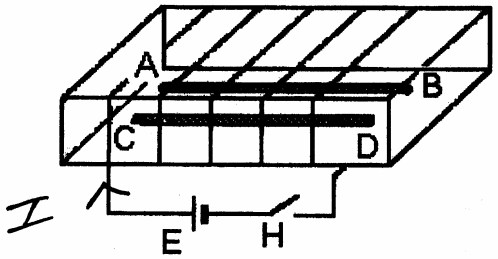
14(a) $M_{ACW} = M_{CW}$ (100 g mass)

$(M_{apple})(g)(d_1) = (100g)(g)(d_2)$

$\therefore M_{apple} = 100 \times \frac{d_2}{d_1}$ grams

- To increase the reliability of results
  → confirm the results by repeating the experiment a few times and taking the average of the results obtained
  → also, check the results obtained with the mass reading as measured using an accurate electronic mass balance.

(ii) Two cylindrical rods, AB of soft iron and CD of hard steel rest side by side on the flat base of a horizontal solenoid of rectangular cross-section as shown in the diagram below.



Describe and explain what happens to each of the rods and how they react to each other when

- a large direct current flows in the solenoid from the battery by closing H; [2]

When a large current flows in solenoid a strong magnetic field is set up in the solenoid. This magnetic field magnetises the same end of the rods (A and C) to be N-poles at the same time, and B and D becomes S-poles. Since like poles repel, A repels C, and B repels D, and the rods move apart.

- the current is switched off by opening H. [2]

When switched off, steel retains its magnetism, while soft iron loses its magnetism. The permanent magnet CD will attract the soft iron rod AB, and they will come together as AB becomes an induced magnet (A: S-pole and B: N-pole) because unlike poles attract.

15(a) The figure 15A shows two identical glass cylinders containing equal volumes of water, initially at room temperatures. Identical electric heaters were placed in the cylinders, near the top in cylinder A and near the bottom in cylinder B.

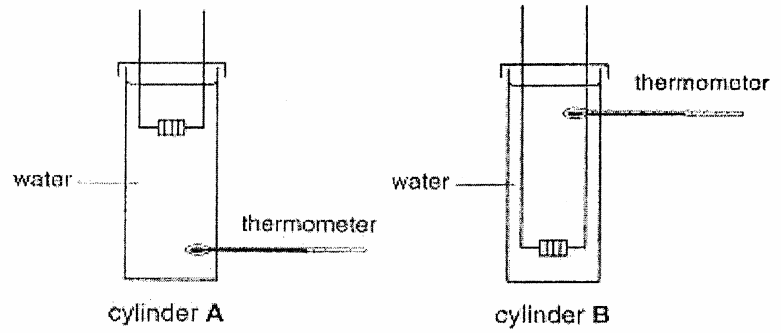


Figure 15A

The heaters were switched on at the same time. The readings of the thermometers then changed as shown in the figure 15B.

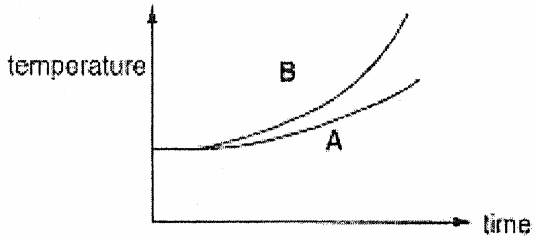


Figure 15B

Explain

(i) how heat is spread in a liquid by convection, [2]

When heated, the molecules move farther apart, the liquid volume increases, and hence becomes less dense, rising up above cooler surrounding liquid that is denser. Heated liquid rises up, carrying heat around, while cooler liquid sinks to be heated, in a cycle.

(ii) why the thermometer reading in cylinder A initially shows a slower rate of increase than that in B. [4]

In A, the heat from heater is conducted downwards through water, and water is a poor conductor of heat. Heat cannot travel downwards via convection currents in A because hot water, being less dense, cannot sink downwards.
In B, heat from the heater is conducted upwards through water, and since heated water expands, increase in volume and rise (because it becomes less dense), heat travels up to thermometer in B via convection (but not in A).
The convection heat transfer in B is an extra mechanism to transfer heat in B (than in A), and is a much faster process than conduction of heat through water.

(9)

(b) Two metal cans are identical except that one has a blackened outer surface and the other has a polished outer surface. They are both filled with a hot liquid at the same initial temperature and then placed in a shaded room. The freezing point of the liquid is 70° C. Figure 15C is a temperature-time graph from the blackened can.

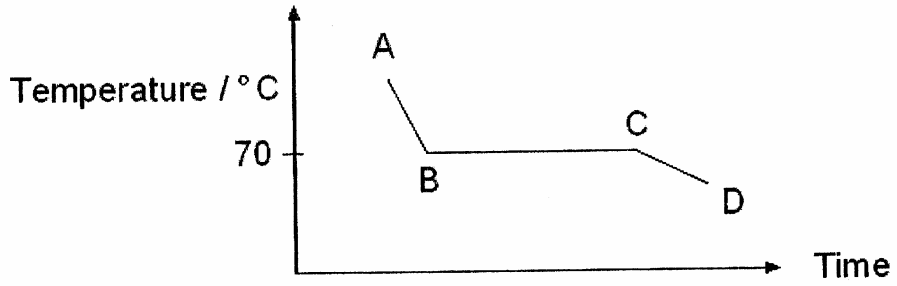


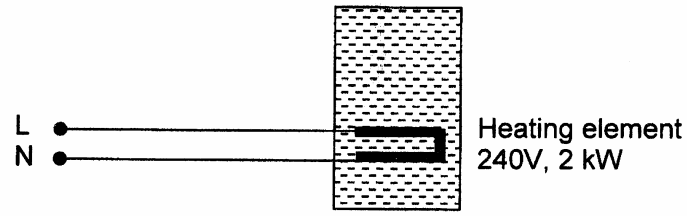
Figure 15C

A temperature-time graph for the polished can is then drawn. Copy the figure 15C onto your answer paper and draw the graph for the polished can. State what are the differences if any, you would expect to observe in sections AB, BC and CD of the two graphs. [4]

A polished surface is a poor emitter of heat radiation than a blackened surface, and hence loses heat at a slower rate. The drop in temperature per unit time is smaller.
Hence, AB and CD would be less steep (smaller temperature drop per unit time) for a polished surface compared to a blackened surface. However, both surfaces will have the same initial and final temperatures for AB and CD.
The freezing point remains constant at 70°C and BC would still be a horizontal line for the polished surface, but the time taken for BC for the polished surface is much longer as the rate of heat radiated away from polished surface is much smaller.

(10)

16. The diagram below shows part of a household electrical installation where an electric heater is used to heat the water in a metal tank.
The heater has a power rating of 240V, 2.0 kW.



(a) Calculate the current flowing in the wires. [2]

$P = IV \quad I = \frac{P}{V} = \frac{2000\ W}{240\ V} = 8.333\ A \simeq 8.3\ A$

(b) You are given fuses with the following ratings: 5 A, 10 A and 13 A. State and explain which fuse you would choose for this heater. [2]

10A. The fuse rating (10A) must be slightly higher than the rated current (8.3 A) of the heating element so that the heating element can work normally, but still be protected from damage should there be a current surge.

(c) On which wire, the live or the neutral should the fuse be placed? Explain your answer. [2]

Live. When there is a current surge (excessive current), and the fuse melts due to overheating, the appliance (heating element) will be isolated from the mains and not be charged at a high voltage.

(d) Many electrical devices have **three** wires running to them. Name the third wire. What is the purpose of the third wire? [2]

Earth wire. Connected to the metal casing of device and grounded to earth (0V). When there is a fault and the live wire touches the metal casing, it provides a low resistance path for current to flow so that the large current can blow the fuse

(e) Calculate the cost of using this water heater for 30 minutes if the cost of electricity is $0.25 per unit. [2]

$\text{Cost} = \text{kW} \times \text{hours} \times \text{per unit \$}$

$= 2 \times \frac{30}{60} \times \$0.25 = \$0.25$